

Stanislaus Temperature Modeling 2015 Proposed Operations Water Allocation Schedule – March 15, 2015

1. Objective

The objective of this work is to assess, using the HEC-5Q Model, the expected temperature conditions at discrete points along the Stanislaus River, given the currently proposed water release schedule from New Melones through the end of 2015.

2. Background

Review of snow pack data from several CDEC stations in or near the Stanislaus watershed indicates that the runoff this year will likely be the lowest of the past 30+ years (see Figure 3).

The Tri-Dam Project is estimating that the total inflow to New Melones from March 1 to September 30 of this year will be in the order of 90,000 acre-feet with the majority of the inflow occurring in March, April and May. For modeling purposes, it is also assumed that the inflow in October will be in the order of 3,000 acre-feet.

The closest historical hydrologic condition to the current year appears to be the dry year of 1987 and even then, the historical inflow to New Melones exceeded the current runoff projection.

3. Modeling Approach

The modeling approach under this scope of work is to use 1987 as an example year in terms of the climate conditions and pattern of runoff, yet to scale down the historical inflow to New Melones to match the 90,000 and 3,000 acre-feet projections, as follows:

| | | | Historical inflow , AF | Ratio:Historical to 90 & 3 TAF |
|-------|------|-------------|---------------------------|-----------------------------------|
| 1-Mar | thru | 30-Sep-1987 | 295,412 | 0.305 |
| 1-Oct | thru | 31-Oct-1987 | 12,175 | 0.246 |

Figure 1: Scaling Factors from Historical Inflow to Projected Inflow

Then, set the New Melones storage to the current state (605,600 acre-feet on February 28), superimpose the release and diversion schedule that is currently being proposed (see Diversion and Release Schedule below), and operate the system accordingly.

This approach will enable estimating the temperature conditions that might be experienced at various locations along the Stanislaus (e.g., below Goodwin Dam, Knights Ferry, Orange Blossom Bridge and Oakdale) through the end of 2015.

It should be noted that given the extremely low water level in New Melones at the present time, it is probable that the old Melones Dam will be exposed, similar to what had happened in the drought of 1987-1992. The model will simulate the old-new dam interaction, including the switch from power plant flow to low-level outlet release and the ramification of this kind of operation on the temperature response below Goodwin Dam and downriver.

4. Diversion and Release Schedule

The proposed diversion schedule from the Goodwin Pool to OID and SSJID and the release to the river from Goodwin Dam, as obtained from the stakeholders, are as follows:

| New Melones Ops - Water Allocation 3/15/2015 | | |
|---|------------------------------|-----------------------------|
| Beginning | Goodwin OID/SSJID | Goodwin To River |
| | TAF | CFS |
| March 1, 2015 | 28.2 | 200 |
| April 1, 2015 | 20.3 | 200 |
| April 16, 2015 | 20.3 | 500 |
| May 1, 2015 | 28.5 | 500 |
| May 16, 2015 | 30.4 | 150 |
| June 1, 2015 | 73.3 | 150 |
| July 1, 2015 | 75.0 | 150 |
| August 1, 2015 | 67.9 | 150 |
| September 1, 2015 | 42.3 | 150 |
| October 1, 2015 | 8.1 | 175 |
| November 1, 2015 | 0.0 | 200 |
| December 1, 2015 | 0.0 | 200 |

Figure 2: Proposed Diversion and Release Schedule

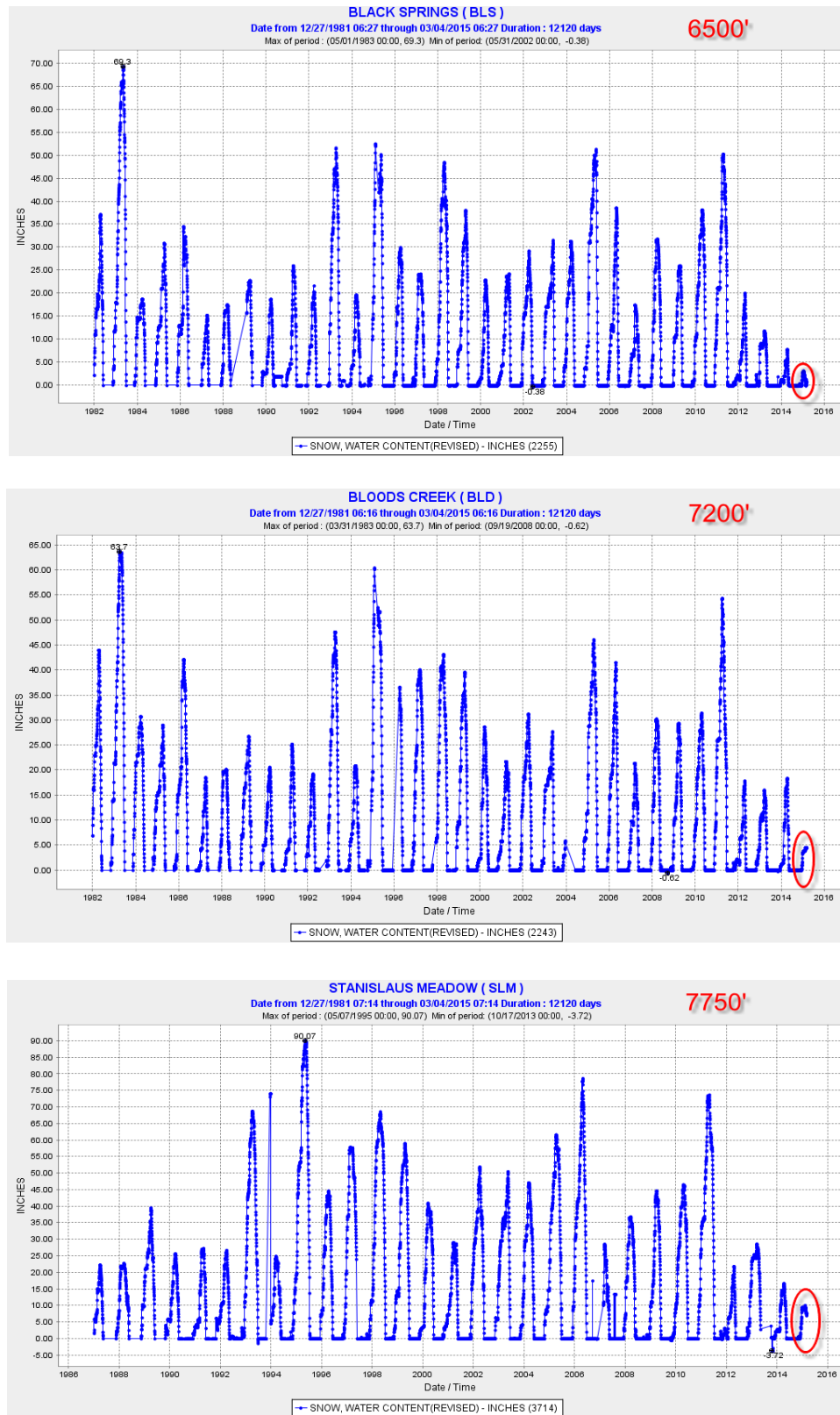


Figure 3: Snow Pack Data from Several CDEC Stations near the Stanislaus watershed

5. Tasks:

1. Set up the data to run a year similar to 1987:
 - a. Process the hydrological and meteorological data.
 - b. Define volume such that the storage at the end of February 28 is 605,600 acre-feet.
 - c. Scale down the May - September flow & October flows by the ratios shown in Figure 1.
 - d. Assume monthly average diversion and New Melones outflow, as specified the Diversion and Release Schedule in Figure 2.
 - e. Prepare DSS inputs for the above.
2. Set up the model to run the modified 1987.
3. Run the model - generate output as directed.
4. QA/QC of results with emphasis on new-old dam interaction.
5. Analyze the results in terms of the expected temperatures at the specified locations along the Stanislaus River from day 1 of the simulation to end-of-year 2015.
6. Evaluate the merit of different strategies for switching from power plant flow to low-level outlet release from New Melones.
7. Compile a short write up about study findings.
8. Present results to the client.

Modeling, Analysis and Findings

1. Model Setup

The HEC-5Q was set to simulate a single year similar to 1987 in terms of the pattern of inflow to New Melones except that the rate of the inflow was scaled down in accordance with Figure 1 above. The meteorological conditions were also set to match the historical conditions in 1987.

In order to prime the model, the simulation started on January 1, 1987 where by New Melones storage was set in such a way that by February 28 the total volume of water in the reservoir would equal to the observed volume on that date, i.e., 605,600 acre-feet. The computed temperature profiles in New Melones and Tulloch were then compared with observed data near March 1 from other years (see Figure 4 below) to ensure that the boundary condition as far as the thermal structures in the reservoirs are reasonable (note that in Figure 4 the New Melones elevation is completely different, however the temperature ranges and profile shapes are similar in both reservoirs).

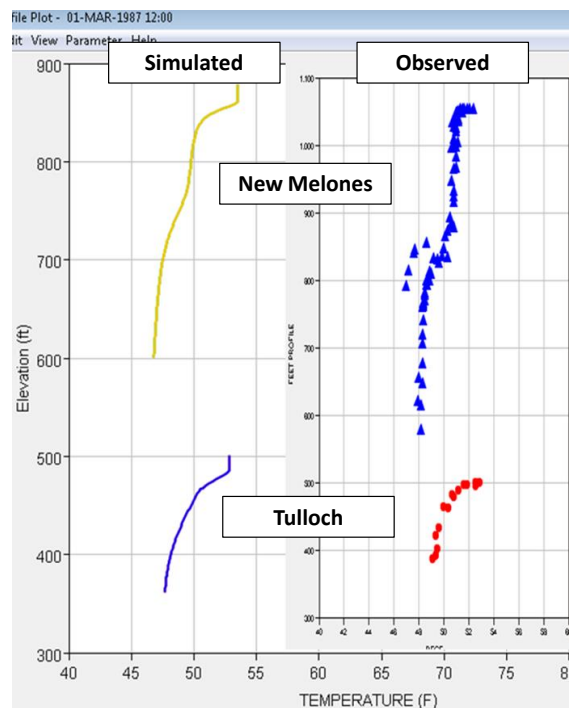


Figure 4: Computed and Observed Thermal Profiles in New Melones and Tulloch Reservoirs near March 1

2. Simulation Modes

The HEC-5Q was run in two modes:

- a) No-Bypass Operation – under this mode, New Melones was operated in a way where the water is released through the power plant until the water level in the reservoir reaches the minimum power pool elevation.
- b) Bypass Operation – under this mode, New Melones was operated in a way where the release is switched gradually from power release to low-level outlet release in advance of reaching minimum power pool elevation.

For the latter, several strategies for bypass operation were analyzed in terms of the starting date and the rate of transitioning from no-bypass to full-bypass operation, as explained below.

3. Projected New Melones Storage

The effect on New Melones Storage is essentially the same for the two operation modes described above. Mass-balance calculation on New Melones for the period March 1 through December 31, 2015 is shown in Figure 5 below:

| New Melones Ops - Projected Storage and Water Levels | | | | | |
|---|-----------|----------------------|---------------------|-------------------------|---------------------------|
| Beginning | NM Inflow | Goodwin OID/SSJID | Goodwin To River | NM Projected Storage | NM Projected Elevation |
| | TAF | TAF | CFS | TAF | FT |
| March 1, 2015 | 16.7 | 28.2 | 200 | 605 | 879 |
| April 1, 2015 | 7.8 | 20.3 | 200 | 579 | 874 |
| April 16, 2015 | 11.3 | 20.3 | 500 | 556 | 869 |
| May 1, 2015 | 7.8 | 28.5 | 500 | 529 | 863 |
| May 16, 2015 | 4.8 | 30.4 | 150 | 489 | 855 |
| June 1, 2015 | 6.6 | 73.3 | 150 | 454 | 847 |
| July 1, 2015 | 12.0 | 75.0 | 150 | 375 | 828 |
| August 1, 2015 | 11.5 | 67.9 | 150 | 299 | 808 |
| September 1, 2015 | 11.5 | 42.3 | 150 | 231 | 786 |
| October 1, 2015 | 3.0 | 8.1 | 175 | 192 | 773 |
| November 1, 2015 | 2.1 | 0.0 | 200 | 182 | 769 |
| December 1, 2015 | 0.9 | 0.0 | 200 | 171 | 764 |
| Note: NM Projected storage includes estimated evaporation and release to Tulloch to meet target levels. | | | | | |

Figure 5: Mass balance on New Melones for the period March 1 to December 31, 2015

The figure shows that the projected storage in New Melones on November 1 is 182 TAF corresponding to El. 769. This reduction in storage takes into consideration the net effect of New Melones and Tulloch evaporation, including local runoff to Tulloch (which was assumed to be similar to 1987).

The gradual decline of water levels in the reservoir from March through December is shown in Figure 6 below. The figure shows that given the assumed inflow to New Melones and proposed outflow (diversion plus release to river), the water will probably not recede to the point where the submerged old Melones Dam will be exposed. However, the depressed water levels in the reservoir will greatly affect the water temperatures downstream as the warm water epilimnion (the top-most layer) will be discharged from the reservoir through the power intake. It should be noted that in both operation modes power flow will cease as the reservoir reaches the minimum power pool at El. 785 (usually around September 1) and water will be discharged at that point through the low-level outlet in New Melones Dam.

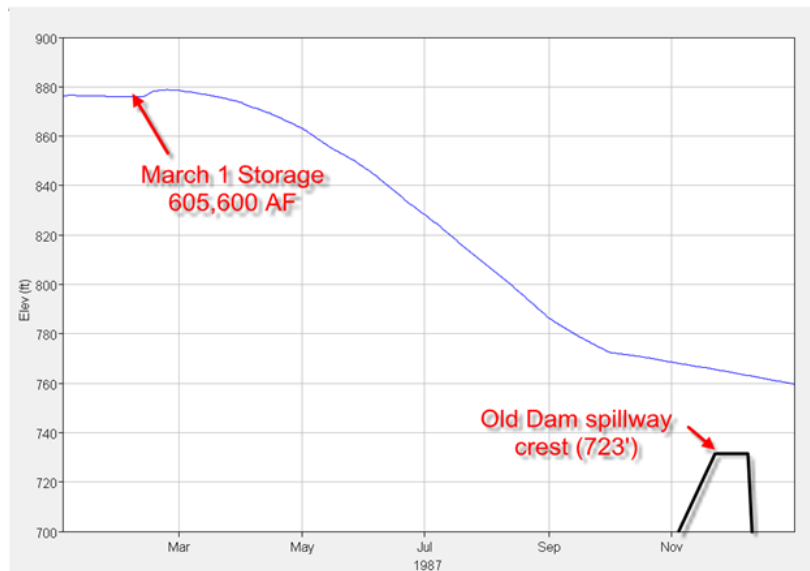


Figure 6: Projected New Melones Water Levels in 2015

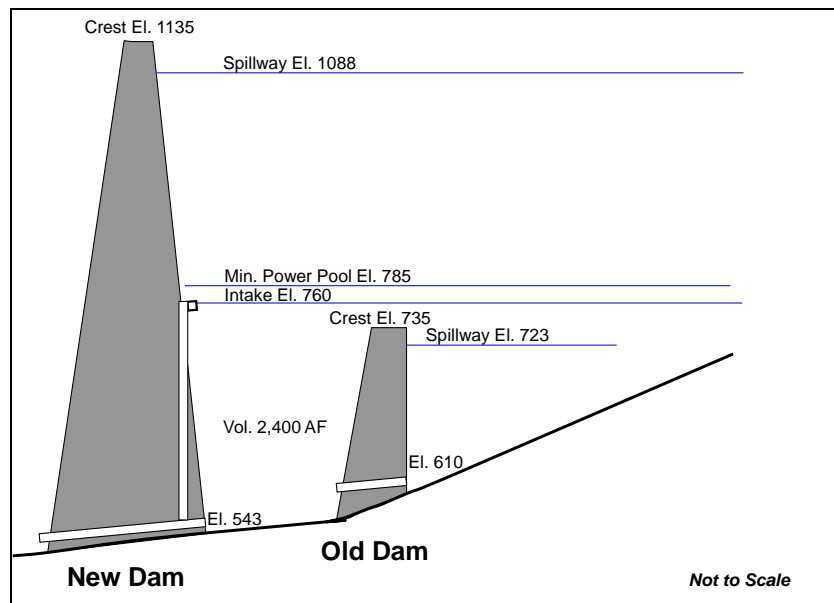


Figure 7: New-Old Dam Interaction

4. Projected Downriver Temperature Response – No-Bypass Operation

The following tables show the results for the temperature response at six discrete points along the Stanislaus River:

- 1) Below Goodwin Dam
- 2) Knights Ferry
- 3) Orange Blossom Bridge
- 4) Highway 120 Bridge (Oakdale)
- 5) Ripon Gage (Highway 99)
- 6) Above the confluence with the San Joaquin River

The results are presented in terms of the 7-Days Average of Daily Maximums (7DADM). In other words, each number in the table is the sum of the maximum daily temperatures in past seven days divided by 7. This term is consistent with EPA's recommended criterion for assessing fish viability.

Notice the precipitous drop of temperatures (almost 10 Deg-F below Goodwin Dam) from September on. This is due to the abrupt switch from no-bypass to full-bypass operation on September 1 (due to power constraints).

Table 1: Temperature Response – 7DADM
March-April, 2015

| | BLW GOODWIN | KNIGHTS FERRY | ORANGE BLOSSOM | HYW 120 BRIDGE | RIPON GAGE | ABV SJR |
|--------|-------------|---------------|----------------|----------------|------------|-----------|
| | NO BYPASS | NO BYPASS | NO BYPASS | NO BYPASS | NO BYPASS | NO BYPASS |
| | 7DADM | 7DADM | 7DADM | 7DADM | 7DADM | 7DADM |
| | DEGF | DEGF | DEGF | DEGF | DEGF | DEGF |
| 1-Mar | 50.5 | 50.6 | 52.2 | 52.3 | 55.4 | 55.6 |
| 2-Mar | 50.6 | 50.8 | 52.5 | 52.5 | 55.7 | 55.9 |
| 3-Mar | 50.8 | 51.1 | 53.0 | 53.1 | 56.4 | 56.6 |
| 4-Mar | 50.8 | 51.2 | 53.3 | 53.5 | 56.9 | 57.1 |
| 5-Mar | 50.7 | 51.2 | 53.4 | 53.8 | 57.2 | 57.5 |
| 6-Mar | 50.7 | 51.3 | 53.6 | 54.1 | 57.5 | 57.8 |
| 7-Mar | 50.8 | 51.4 | 53.8 | 54.4 | 57.9 | 58.2 |
| 8-Mar | 50.9 | 51.5 | 53.9 | 54.6 | 58.1 | 58.4 |
| 9-Mar | 51.0 | 51.5 | 54.0 | 54.7 | 58.4 | 58.6 |
| 10-Mar | 51.0 | 51.5 | 54.0 | 54.7 | 58.4 | 58.7 |
| 11-Mar | 51.3 | 51.7 | 54.1 | 54.8 | 58.6 | 58.8 |
| 12-Mar | 51.6 | 52.0 | 54.6 | 55.2 | 59.2 | 59.3 |
| 13-Mar | 51.8 | 52.2 | 54.9 | 55.6 | 59.7 | 59.8 |
| 14-Mar | 51.8 | 52.2 | 54.9 | 55.7 | 59.9 | 59.9 |
| 15-Mar | 51.9 | 52.3 | 54.8 | 55.7 | 60.0 | 60.0 |
| 16-Mar | 51.9 | 52.3 | 54.8 | 55.6 | 60.0 | 60.1 |
| 17-Mar | 52.0 | 52.4 | 54.9 | 55.6 | 60.0 | 60.2 |
| 18-Mar | 52.0 | 52.4 | 54.8 | 55.6 | 59.8 | 60.1 |
| 19-Mar | 51.9 | 52.3 | 54.6 | 55.3 | 59.5 | 59.8 |
| 20-Mar | 51.9 | 52.3 | 54.4 | 55.1 | 59.1 | 59.5 |
| 21-Mar | 52.0 | 52.3 | 54.4 | 55.0 | 58.9 | 59.3 |
| 22-Mar | 52.1 | 52.5 | 54.6 | 55.1 | 58.9 | 59.3 |
| 23-Mar | 52.2 | 52.5 | 54.5 | 55.0 | 58.8 | 59.1 |
| 24-Mar | 52.2 | 52.5 | 54.5 | 55.0 | 58.7 | 58.9 |
| 25-Mar | 52.3 | 52.7 | 54.7 | 55.2 | 58.8 | 59.0 |
| 26-Mar | 52.5 | 52.8 | 55.0 | 55.5 | 59.2 | 59.3 |
| 27-Mar | 52.6 | 53.0 | 55.3 | 55.9 | 59.5 | 59.7 |
| 28-Mar | 52.8 | 53.3 | 55.8 | 56.4 | 60.1 | 60.3 |
| 29-Mar | 52.9 | 53.5 | 56.2 | 56.9 | 60.5 | 60.7 |
| 30-Mar | 53.1 | 53.8 | 56.8 | 57.5 | 61.1 | 61.4 |
| 31-Mar | 53.3 | 54.1 | 57.3 | 58.0 | 61.7 | 61.9 |
| 1-Apr | 53.3 | 54.3 | 57.7 | 58.6 | 62.2 | 62.5 |
| 2-Apr | 53.4 | 54.4 | 58.0 | 59.0 | 62.7 | 62.9 |
| 3-Apr | 53.4 | 54.5 | 58.2 | 59.3 | 63.1 | 63.2 |
| 4-Apr | 53.4 | 54.5 | 58.3 | 59.5 | 63.4 | 63.5 |
| 5-Apr | 53.3 | 54.6 | 58.4 | 59.6 | 63.7 | 63.8 |
| 6-Apr | 53.3 | 54.6 | 58.5 | 59.8 | 64.1 | 64.2 |
| 7-Apr | 53.3 | 54.7 | 58.7 | 60.0 | 64.7 | 64.7 |
| 8-Apr | 53.3 | 54.8 | 58.8 | 60.2 | 65.2 | 65.2 |
| 9-Apr | 53.4 | 54.8 | 58.9 | 60.4 | 65.7 | 65.7 |
| 10-Apr | 53.4 | 54.9 | 59.0 | 60.6 | 66.1 | 66.3 |
| 11-Apr | 53.5 | 55.0 | 59.1 | 60.8 | 66.5 | 66.7 |
| 12-Apr | 53.7 | 55.1 | 59.4 | 61.1 | 66.9 | 67.2 |
| 13-Apr | 53.8 | 55.3 | 59.7 | 61.4 | 67.4 | 67.7 |
| 14-Apr | 53.9 | 55.5 | 60.0 | 61.8 | 67.9 | 68.3 |
| 15-Apr | 53.8 | 55.5 | 60.1 | 62.0 | 68.4 | 68.8 |
| 16-Apr | 53.8 | 55.4 | 60.0 | 61.9 | 68.8 | 69.4 |
| 17-Apr | 53.8 | 55.4 | 59.8 | 61.7 | 69.0 | 69.9 |
| 18-Apr | 53.7 | 55.2 | 59.4 | 61.3 | 68.8 | 69.9 |
| 19-Apr | 53.6 | 55.1 | 59.0 | 60.8 | 68.4 | 69.8 |
| 20-Apr | 53.5 | 54.9 | 58.6 | 60.3 | 67.8 | 69.4 |
| 21-Apr | 53.5 | 54.8 | 58.1 | 59.7 | 67.2 | 68.9 |
| 22-Apr | 53.5 | 54.7 | 57.9 | 59.3 | 66.4 | 68.2 |
| 23-Apr | 53.6 | 54.7 | 57.7 | 59.0 | 65.6 | 67.4 |
| 24-Apr | 53.7 | 54.8 | 57.8 | 58.9 | 65.1 | 66.7 |
| 25-Apr | 53.8 | 55.0 | 58.1 | 59.2 | 65.1 | 66.6 |
| 26-Apr | 53.9 | 55.2 | 58.4 | 59.6 | 65.3 | 66.7 |
| 27-Apr | 54.0 | 55.4 | 58.7 | 60.0 | 65.8 | 67.0 |
| 28-Apr | 54.1 | 55.4 | 58.8 | 60.2 | 66.0 | 67.2 |
| 29-Apr | 54.2 | 55.5 | 59.0 | 60.3 | 66.3 | 67.4 |
| 30-Apr | 54.2 | 55.6 | 59.0 | 60.4 | 66.5 | 67.6 |

**Table 2: Temperature Response – 7DADM
May-June, 2015**

| | BLW GOODWIN | KNIGHTS FERRY | ORANGE BLOSSOM | HYW 120 BRIDGE | RIPON GAGE | ABV SJR |
|--------|-------------|---------------|----------------|----------------|------------|-----------|
| | NO BYPASS | NO BYPASS | NO BYPASS | NO BYPASS | NO BYPASS | NO BYPASS |
| | 7DADM | 7DADM | 7DADM | 7DADM | 7DADM | 7DADM |
| | DEGF | DEGF | DEGF | DEGF | DEGF | DEGF |
| 1-May | 54.2 | 55.5 | 58.9 | 60.3 | 66.4 | 67.6 |
| 2-May | 54.2 | 55.5 | 58.8 | 60.2 | 66.4 | 67.5 |
| 3-May | 54.2 | 55.4 | 58.7 | 60.0 | 66.1 | 67.3 |
| 4-May | 54.1 | 55.4 | 58.5 | 59.8 | 65.8 | 67.0 |
| 5-May | 54.1 | 55.4 | 58.6 | 59.8 | 65.7 | 67.0 |
| 6-May | 54.2 | 55.5 | 58.7 | 59.9 | 65.8 | 67.0 |
| 7-May | 54.2 | 55.6 | 58.9 | 60.2 | 66.1 | 67.3 |
| 8-May | 54.3 | 55.8 | 59.2 | 60.5 | 66.6 | 67.8 |
| 9-May | 54.4 | 55.9 | 59.4 | 60.9 | 67.1 | 68.3 |
| 10-May | 54.5 | 56.1 | 59.8 | 61.3 | 67.7 | 68.9 |
| 11-May | 54.6 | 56.2 | 60.1 | 61.6 | 68.2 | 69.4 |
| 12-May | 54.7 | 56.3 | 60.2 | 61.9 | 68.6 | 69.9 |
| 13-May | 54.8 | 56.4 | 60.4 | 62.1 | 69.0 | 70.3 |
| 14-May | 54.8 | 56.5 | 60.6 | 62.3 | 69.4 | 70.7 |
| 15-May | 54.9 | 56.6 | 60.7 | 62.5 | 69.7 | 71.1 |
| 16-May | 55.0 | 56.8 | 60.8 | 62.6 | 69.8 | 71.1 |
| 17-May | 55.0 | 56.9 | 61.1 | 62.8 | 69.8 | 71.1 |
| 18-May | 55.1 | 57.2 | 61.5 | 63.1 | 69.8 | 71.0 |
| 19-May | 55.1 | 57.4 | 61.8 | 63.4 | 69.8 | 70.8 |
| 20-May | 55.1 | 57.4 | 61.9 | 63.6 | 69.5 | 70.5 |
| 21-May | 55.2 | 57.7 | 62.3 | 63.9 | 69.4 | 70.2 |
| 22-May | 55.2 | 57.9 | 62.7 | 64.3 | 69.5 | 70.0 |
| 23-May | 55.2 | 58.0 | 63.1 | 64.9 | 69.8 | 70.0 |
| 24-May | 55.2 | 58.0 | 63.3 | 65.3 | 70.2 | 70.3 |
| 25-May | 55.2 | 58.1 | 63.5 | 65.6 | 70.5 | 70.6 |
| 26-May | 55.2 | 58.1 | 63.5 | 65.7 | 70.7 | 70.7 |
| 27-May | 55.1 | 58.0 | 63.4 | 65.7 | 70.9 | 70.8 |
| 28-May | 55.2 | 58.0 | 63.4 | 65.8 | 71.0 | 71.0 |
| 29-May | 55.2 | 58.0 | 63.4 | 65.8 | 71.2 | 71.1 |
| 30-May | 55.2 | 58.1 | 63.5 | 65.9 | 71.4 | 71.4 |
| 31-May | 55.3 | 58.2 | 63.7 | 66.0 | 71.7 | 71.6 |
| 1-Jun | 55.3 | 58.3 | 64.0 | 66.3 | 72.0 | 72.0 |
| 2-Jun | 55.4 | 58.6 | 64.6 | 66.9 | 72.8 | 72.8 |
| 3-Jun | 55.6 | 59.1 | 65.4 | 67.8 | 73.9 | 73.8 |
| 4-Jun | 55.6 | 59.2 | 65.7 | 68.3 | 74.5 | 74.4 |
| 5-Jun | 55.6 | 59.3 | 66.0 | 68.7 | 74.9 | 74.8 |
| 6-Jun | 55.6 | 59.4 | 66.3 | 69.1 | 75.4 | 75.3 |
| 7-Jun | 55.7 | 59.6 | 66.7 | 69.6 | 76.0 | 75.9 |
| 8-Jun | 55.8 | 59.7 | 67.0 | 69.9 | 76.4 | 76.4 |
| 9-Jun | 55.8 | 59.7 | 67.0 | 70.1 | 76.6 | 76.6 |
| 10-Jun | 55.9 | 59.8 | 67.0 | 70.1 | 76.6 | 76.6 |
| 11-Jun | 56.0 | 60.0 | 67.3 | 70.4 | 76.9 | 76.9 |
| 12-Jun | 56.2 | 60.3 | 67.8 | 70.8 | 77.4 | 77.4 |
| 13-Jun | 56.3 | 60.5 | 68.1 | 71.2 | 77.8 | 77.8 |
| 14-Jun | 56.3 | 60.5 | 68.2 | 71.4 | 77.9 | 77.9 |
| 15-Jun | 56.4 | 60.5 | 68.1 | 71.3 | 77.9 | 77.8 |
| 16-Jun | 56.4 | 60.5 | 68.0 | 71.3 | 77.8 | 77.7 |
| 17-Jun | 56.4 | 60.4 | 67.8 | 71.1 | 77.6 | 77.6 |
| 18-Jun | 56.5 | 60.4 | 67.7 | 70.9 | 77.5 | 77.5 |
| 19-Jun | 56.5 | 60.3 | 67.5 | 70.7 | 77.4 | 77.3 |
| 20-Jun | 56.5 | 60.1 | 67.1 | 70.4 | 77.0 | 77.0 |
| 21-Jun | 56.6 | 60.1 | 66.9 | 70.1 | 76.7 | 76.7 |
| 22-Jun | 56.7 | 60.2 | 66.9 | 70.0 | 76.6 | 76.6 |
| 23-Jun | 56.8 | 60.3 | 67.1 | 70.0 | 76.6 | 76.7 |
| 24-Jun | 57.0 | 60.6 | 67.5 | 70.4 | 77.0 | 77.0 |
| 25-Jun | 57.1 | 60.8 | 67.9 | 70.8 | 77.4 | 77.5 |
| 26-Jun | 57.2 | 61.1 | 68.3 | 71.3 | 77.9 | 78.0 |
| 27-Jun | 57.3 | 61.4 | 68.8 | 71.9 | 78.6 | 78.6 |
| 28-Jun | 57.4 | 61.6 | 69.2 | 72.5 | 79.3 | 79.2 |
| 29-Jun | 57.5 | 61.7 | 69.6 | 72.9 | 79.9 | 79.8 |
| 30-Jun | 57.6 | 61.8 | 69.7 | 73.2 | 80.2 | 80.2 |

Table 3: Temperature Response – 7DADM
July-August, 2015

| | BLW GOODWIN | KNIGHTS FERRY | ORANGE BLOSSOM | HYW 120 BRIDGE | RIPON GAGE | ABV SJR |
|--------|-------------|---------------|----------------|----------------|------------|-----------|
| | NO BYPASS | NO BYPASS | NO BYPASS | NO BYPASS | NO BYPASS | NO BYPASS |
| | 7DADM | 7DADM | 7DADM | 7DADM | 7DADM | 7DADM |
| | DEGF | DEGF | DEGF | DEGF | DEGF | DEGF |
| 1-Jul | 57.7 | 61.9 | 69.7 | 73.3 | 80.3 | 80.3 |
| 2-Jul | 57.8 | 61.8 | 69.5 | 73.1 | 80.2 | 80.2 |
| 3-Jul | 57.8 | 61.7 | 69.1 | 72.7 | 79.8 | 79.8 |
| 4-Jul | 57.9 | 61.6 | 68.9 | 72.4 | 79.5 | 79.5 |
| 5-Jul | 58.1 | 61.7 | 68.8 | 72.1 | 79.2 | 79.3 |
| 6-Jul | 58.2 | 61.7 | 68.7 | 71.9 | 78.9 | 79.0 |
| 7-Jul | 58.4 | 61.9 | 68.8 | 71.9 | 78.9 | 78.9 |
| 8-Jul | 58.6 | 62.0 | 69.0 | 72.0 | 78.9 | 78.9 |
| 9-Jul | 58.7 | 62.2 | 69.2 | 72.2 | 78.9 | 78.9 |
| 10-Jul | 58.9 | 62.5 | 69.5 | 72.5 | 79.1 | 79.1 |
| 11-Jul | 59.1 | 62.6 | 69.8 | 72.8 | 79.3 | 79.3 |
| 12-Jul | 59.2 | 62.9 | 70.0 | 73.0 | 79.5 | 79.4 |
| 13-Jul | 59.4 | 63.1 | 70.3 | 73.3 | 79.8 | 79.7 |
| 14-Jul | 59.6 | 63.2 | 70.5 | 73.5 | 79.9 | 79.8 |
| 15-Jul | 59.7 | 63.4 | 70.7 | 73.8 | 80.2 | 80.0 |
| 16-Jul | 59.8 | 63.5 | 70.7 | 73.9 | 80.3 | 80.2 |
| 17-Jul | 59.9 | 63.5 | 70.6 | 73.8 | 80.3 | 80.2 |
| 18-Jul | 60.1 | 63.5 | 70.5 | 73.7 | 80.2 | 80.2 |
| 19-Jul | 60.2 | 63.5 | 70.3 | 73.5 | 80.1 | 80.0 |
| 20-Jul | 60.3 | 63.4 | 70.1 | 73.2 | 79.8 | 79.8 |
| 21-Jul | 60.4 | 63.4 | 69.9 | 72.9 | 79.5 | 79.5 |
| 22-Jul | 60.6 | 63.3 | 69.6 | 72.5 | 79.1 | 79.1 |
| 23-Jul | 60.7 | 63.3 | 69.3 | 72.1 | 78.6 | 78.7 |
| 24-Jul | 60.9 | 63.4 | 69.3 | 71.9 | 78.4 | 78.5 |
| 25-Jul | 61.1 | 63.6 | 69.4 | 71.9 | 78.3 | 78.3 |
| 26-Jul | 61.2 | 63.7 | 69.4 | 71.8 | 78.1 | 78.2 |
| 27-Jul | 61.4 | 63.8 | 69.4 | 71.8 | 78.0 | 78.1 |
| 28-Jul | 61.6 | 64.0 | 69.6 | 71.9 | 78.0 | 78.1 |
| 29-Jul | 61.8 | 64.1 | 69.7 | 72.0 | 78.0 | 78.1 |
| 30-Jul | 62.0 | 64.3 | 69.9 | 72.2 | 78.1 | 78.1 |
| 31-Jul | 62.1 | 64.5 | 70.0 | 72.3 | 78.1 | 78.1 |
| 1-Aug | 62.3 | 64.7 | 70.3 | 72.5 | 78.3 | 78.3 |
| 2-Aug | 62.5 | 64.9 | 70.6 | 72.8 | 78.6 | 78.6 |
| 3-Aug | 62.8 | 65.2 | 70.9 | 73.2 | 79.0 | 79.0 |
| 4-Aug | 62.9 | 65.2 | 70.9 | 73.2 | 79.0 | 79.1 |
| 5-Aug | 63.1 | 65.4 | 71.0 | 73.3 | 79.0 | 79.2 |
| 6-Aug | 63.3 | 65.6 | 71.2 | 73.5 | 79.3 | 79.4 |
| 7-Aug | 63.5 | 65.7 | 71.2 | 73.6 | 79.3 | 79.4 |
| 8-Aug | 63.6 | 65.8 | 71.2 | 73.5 | 79.2 | 79.3 |
| 9-Aug | 63.8 | 65.8 | 71.2 | 73.4 | 79.1 | 79.2 |
| 10-Aug | 63.9 | 65.8 | 71.0 | 73.2 | 78.8 | 78.8 |
| 11-Aug | 64.2 | 66.0 | 71.1 | 73.1 | 78.7 | 78.7 |
| 12-Aug | 64.4 | 66.1 | 71.0 | 73.0 | 78.5 | 78.5 |
| 13-Aug | 64.5 | 66.0 | 70.8 | 72.8 | 78.2 | 78.1 |
| 14-Aug | 64.7 | 66.1 | 70.6 | 72.5 | 77.8 | 77.8 |
| 15-Aug | 64.9 | 66.1 | 70.5 | 72.3 | 77.5 | 77.5 |
| 16-Aug | 65.1 | 66.3 | 70.5 | 72.2 | 77.3 | 77.3 |
| 17-Aug | 65.4 | 66.5 | 70.6 | 72.2 | 77.3 | 77.3 |
| 18-Aug | 65.7 | 66.6 | 70.6 | 72.2 | 77.2 | 77.2 |
| 19-Aug | 65.9 | 66.8 | 70.6 | 72.2 | 77.0 | 77.1 |
| 20-Aug | 66.3 | 67.0 | 70.7 | 72.2 | 76.9 | 76.9 |
| 21-Aug | 66.6 | 67.2 | 70.8 | 72.2 | 76.9 | 76.9 |
| 22-Aug | 67.0 | 67.4 | 70.9 | 72.2 | 76.8 | 76.8 |
| 23-Aug | 67.3 | 67.6 | 70.8 | 72.1 | 76.6 | 76.5 |
| 24-Aug | 67.6 | 67.8 | 70.9 | 72.1 | 76.4 | 76.3 |
| 25-Aug | 68.0 | 68.0 | 70.9 | 72.1 | 76.3 | 76.2 |
| 26-Aug | 68.3 | 68.4 | 71.2 | 72.2 | 76.3 | 76.2 |
| 27-Aug | 68.6 | 68.7 | 71.5 | 72.4 | 76.5 | 76.4 |
| 28-Aug | 68.9 | 69.1 | 71.9 | 72.8 | 76.7 | 76.6 |
| 29-Aug | 69.2 | 69.5 | 72.3 | 73.2 | 77.1 | 77.0 |
| 30-Aug | 69.5 | 69.9 | 72.8 | 73.6 | 77.6 | 77.4 |
| 31-Aug | 69.7 | 70.1 | 73.1 | 74.0 | 77.9 | 77.7 |

**Table 4: Temperature Response – 7DADM
September-October, 2015**

| | BLW GOODWIN | KNIGHTS FERRY | ORANGE BLOSSOM | HYW 120 BRIDGE | RIPON GAGE | ABV SJR |
|--------|-------------|---------------|----------------|----------------|------------|-----------|
| | NO BYPASS | NO BYPASS | NO BYPASS | NO BYPASS | NO BYPASS | NO BYPASS |
| | 7DADM | 7DADM | 7DADM | 7DADM | 7DADM | 7DADM |
| | DEGF | DEGF | DEGF | DEGF | DEGF | DEGF |
| 1-Sep | 70.0 | 70.5 | 73.5 | 74.5 | 78.3 | 78.1 |
| 2-Sep | 70.2 | 70.7 | 73.8 | 74.8 | 78.7 | 78.4 |
| 3-Sep | 70.5 | 70.9 | 74.2 | 75.2 | 79.0 | 78.8 |
| 4-Sep | 70.6 | 71.0 | 74.3 | 75.4 | 79.2 | 78.9 |
| 5-Sep | 70.3 | 70.9 | 74.1 | 75.3 | 79.0 | 78.7 |
| 6-Sep | 69.6 | 70.6 | 73.7 | 74.9 | 78.5 | 78.3 |
| 7-Sep | 68.7 | 70.2 | 73.4 | 74.5 | 78.1 | 77.9 |
| 8-Sep | 67.5 | 69.7 | 73.0 | 74.1 | 77.7 | 77.5 |
| 9-Sep | 66.3 | 69.0 | 72.5 | 73.7 | 77.3 | 77.0 |
| 10-Sep | 64.9 | 68.1 | 71.8 | 73.1 | 76.6 | 76.4 |
| 11-Sep | 63.6 | 67.1 | 71.2 | 72.5 | 76.0 | 75.9 |
| 12-Sep | 62.6 | 66.2 | 70.5 | 71.9 | 75.5 | 75.4 |
| 13-Sep | 61.9 | 65.4 | 70.0 | 71.5 | 75.2 | 75.1 |
| 14-Sep | 61.4 | 64.6 | 69.2 | 70.8 | 74.7 | 74.6 |
| 15-Sep | 61.1 | 63.9 | 68.5 | 70.2 | 74.2 | 74.1 |
| 16-Sep | 60.8 | 63.2 | 67.7 | 69.5 | 73.6 | 73.5 |
| 17-Sep | 60.6 | 62.7 | 67.1 | 68.9 | 73.2 | 73.1 |
| 18-Sep | 60.5 | 62.3 | 66.6 | 68.3 | 72.8 | 72.7 |
| 19-Sep | 60.4 | 62.1 | 66.3 | 67.9 | 72.6 | 72.6 |
| 20-Sep | 60.3 | 61.9 | 66.0 | 67.6 | 72.4 | 72.4 |
| 21-Sep | 60.3 | 61.9 | 66.1 | 67.6 | 72.6 | 72.7 |
| 22-Sep | 60.3 | 61.9 | 66.1 | 67.7 | 72.7 | 72.8 |
| 23-Sep | 60.3 | 61.9 | 66.1 | 67.8 | 72.9 | 73.0 |
| 24-Sep | 60.2 | 61.8 | 66.1 | 67.8 | 72.9 | 73.1 |
| 25-Sep | 60.1 | 61.7 | 65.9 | 67.7 | 72.8 | 73.1 |
| 26-Sep | 60.1 | 61.7 | 65.8 | 67.6 | 72.8 | 73.0 |
| 27-Sep | 60.1 | 61.6 | 65.7 | 67.4 | 72.6 | 72.9 |
| 28-Sep | 60.0 | 61.4 | 65.4 | 67.2 | 72.3 | 72.6 |
| 29-Sep | 60.0 | 61.3 | 65.2 | 66.9 | 72.1 | 72.4 |
| 30-Sep | 60.1 | 61.3 | 65.1 | 66.8 | 72.0 | 72.3 |
| 1-Oct | 60.3 | 61.4 | 65.2 | 66.7 | 72.0 | 72.3 |
| 2-Oct | 60.6 | 61.5 | 65.3 | 66.8 | 72.1 | 72.4 |
| 3-Oct | 60.7 | 61.6 | 65.4 | 66.9 | 72.2 | 72.5 |
| 4-Oct | 61.0 | 61.8 | 65.6 | 67.1 | 72.3 | 72.7 |
| 5-Oct | 61.2 | 62.0 | 65.8 | 67.3 | 72.6 | 72.9 |
| 6-Oct | 61.4 | 62.1 | 65.9 | 67.4 | 72.7 | 73.1 |
| 7-Oct | 61.4 | 62.1 | 65.7 | 67.3 | 72.5 | 72.9 |
| 8-Oct | 61.2 | 62.1 | 65.5 | 67.0 | 72.2 | 72.7 |
| 9-Oct | 61.0 | 61.9 | 65.2 | 66.6 | 71.8 | 72.3 |
| 10-Oct | 60.8 | 61.8 | 64.9 | 66.2 | 71.4 | 72.0 |
| 11-Oct | 60.5 | 61.5 | 64.5 | 65.7 | 70.8 | 71.4 |
| 12-Oct | 60.3 | 61.3 | 64.0 | 65.2 | 70.1 | 70.8 |
| 13-Oct | 60.1 | 61.0 | 63.5 | 64.5 | 69.3 | 70.1 |
| 14-Oct | 60.1 | 60.8 | 63.2 | 64.1 | 68.8 | 69.6 |
| 15-Oct | 60.1 | 60.7 | 63.0 | 63.8 | 68.3 | 69.1 |
| 16-Oct | 60.1 | 60.6 | 62.9 | 63.5 | 67.9 | 68.7 |
| 17-Oct | 60.1 | 60.5 | 62.7 | 63.3 | 67.5 | 68.3 |
| 18-Oct | 60.1 | 60.5 | 62.6 | 63.2 | 67.1 | 67.9 |
| 19-Oct | 60.1 | 60.5 | 62.5 | 63.1 | 66.8 | 67.5 |
| 20-Oct | 60.0 | 60.4 | 62.3 | 62.9 | 66.5 | 67.1 |
| 21-Oct | 60.0 | 60.3 | 62.2 | 62.7 | 66.2 | 66.8 |
| 22-Oct | 59.8 | 60.0 | 61.7 | 62.3 | 65.7 | 66.1 |
| 23-Oct | 59.9 | 59.9 | 61.5 | 62.0 | 65.4 | 65.7 |
| 24-Oct | 59.9 | 59.8 | 61.3 | 61.7 | 65.0 | 65.3 |
| 25-Oct | 59.9 | 59.7 | 61.2 | 61.5 | 64.8 | 65.0 |
| 26-Oct | 59.9 | 59.6 | 61.0 | 61.3 | 64.5 | 64.7 |
| 27-Oct | 59.9 | 59.6 | 60.9 | 61.2 | 64.3 | 64.5 |
| 28-Oct | 59.8 | 59.6 | 60.8 | 61.0 | 64.1 | 64.3 |
| 29-Oct | 59.8 | 59.6 | 60.8 | 61.0 | 64.1 | 64.2 |
| 30-Oct | 59.7 | 59.5 | 60.7 | 60.9 | 63.9 | 64.1 |
| 31-Oct | 59.6 | 59.4 | 60.5 | 60.7 | 63.7 | 63.9 |

5. Projected Downriver Temperature Response – Bypass Operation

Bypass operation changes the thermal structure of both New Melones and Tulloch reservoirs and the temperature release below Goodwin, as such. The best way to explain this phenomenon is by way of example:

Figure 8 shows the computed temperature profiles in New Melones and Tulloch reservoirs on September 1 for two cases: A no-bypass case and a bypass case beginning on July 1.

- In the no-bypass case, warmer water outflow from New Melones resulting in little cool water remaining in Tulloch.
- In the bypass case, blending of colder water through the low-level outlet result in a larger warm water epilimnion in New Melones and cooler water in Tulloch (warm water remains in New Melones and not in the river below Goodwin).

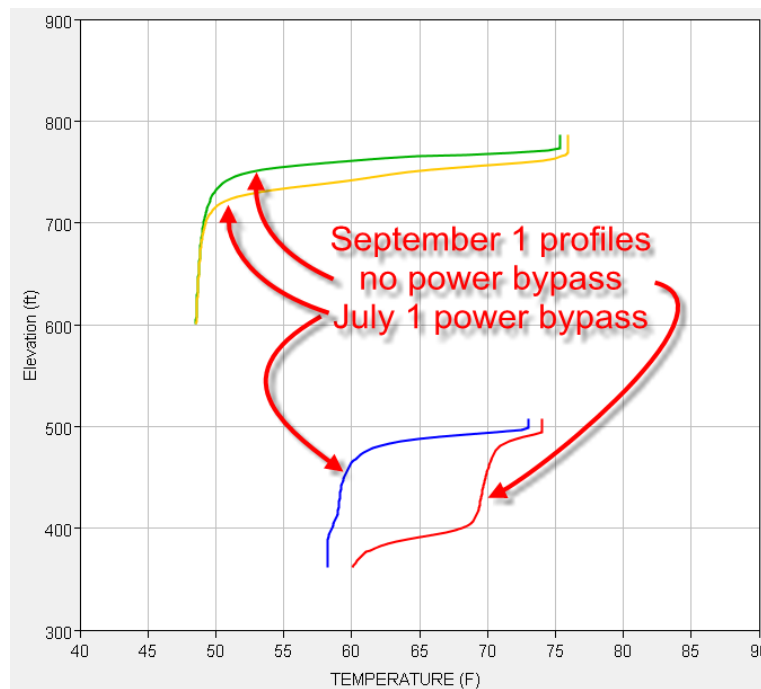


Figure 8: Temperature profiles in New Melones and Tulloch With and Without Bypass Operation

Four options for bypass operations have been considered:

- 1) Bypass starting July 1
- 2) Bypass starting July 15
- 3) Bypass starting August 1
- 4) Bypass starting August 15.

In all cases, the bypass operation was done gradually (assumed linear transition) from the specified starting date until full bypass by early September when New Melones reached its minimum power pool elevation.

The ramification of the bypass operation is a reduction in water temperature below Goodwin Dam (and downriver) in comparison with the no-bypass case, as illustrated in Figure 9 below:

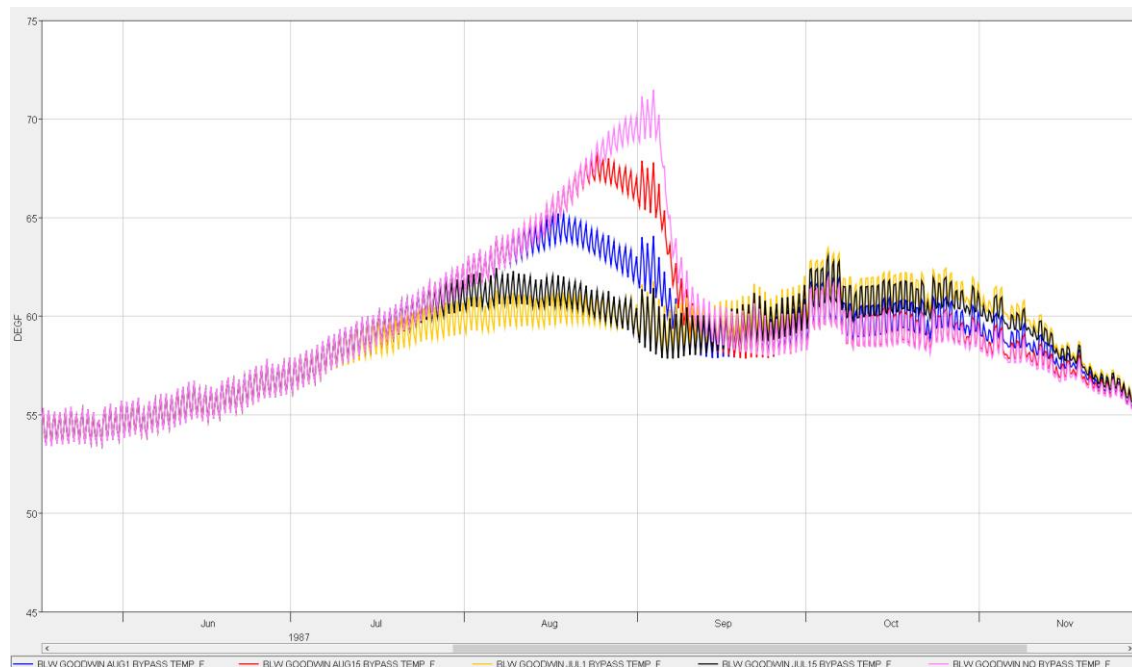


Figure 9: Effects of Power Bypass on Temperature Below Goodwin Dam

Figure 9 shows, that the most dramatic reduction in temperature in late August and early September could be achieved by starting the bypass operation on July 1. However, this type of operation would deplete cold water in New Melones, resulting in elevated water temperature in October. The question which of those bypass operation options provides the most thermal benefit should be dealt with in the context of impact on fish which is not the subject of this analysis.

In addition, the loss of energy production due to the power bypass should also be considered. A simplified power analysis related to this issue is provided below.

Based on visual inspection of the results, the July 15 bypass case was selected as the representative bypass case as it shows an overall moderation of temperatures throughout the bypass period.

The results are presented in two ways:

- A. Graphical form - showing the daily maximum temperatures
- B. Tabular form - showing the 7-Days Average of Daily Maximums (7DADM).

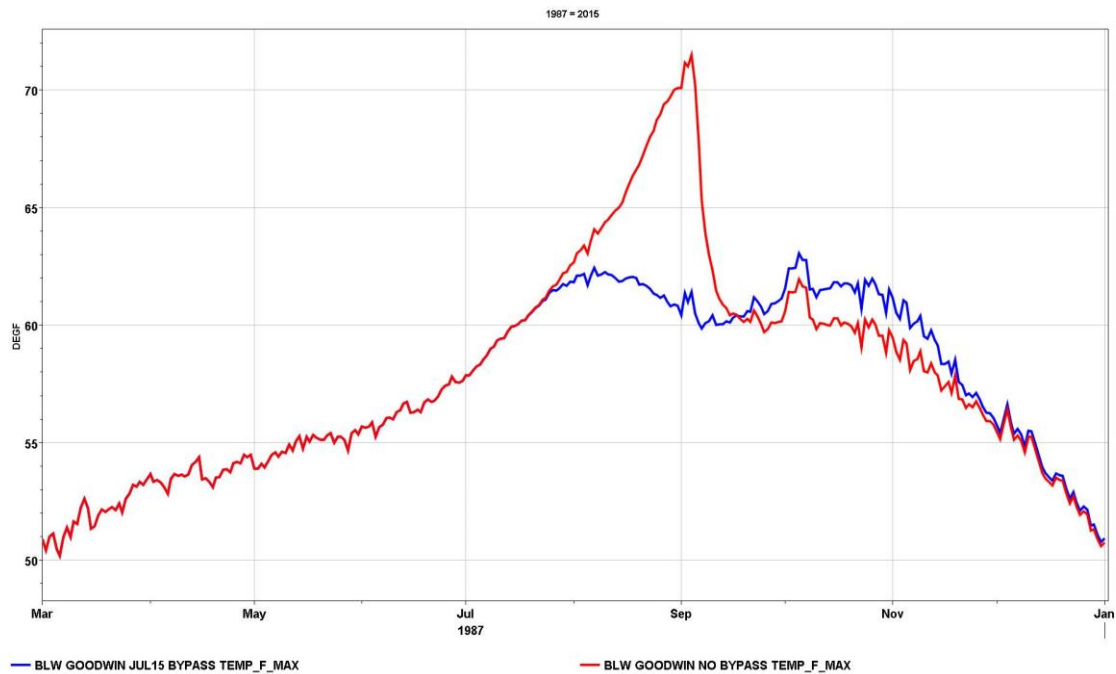


Figure 10 : Maximum Daily Temperatures below Goodwin Dam

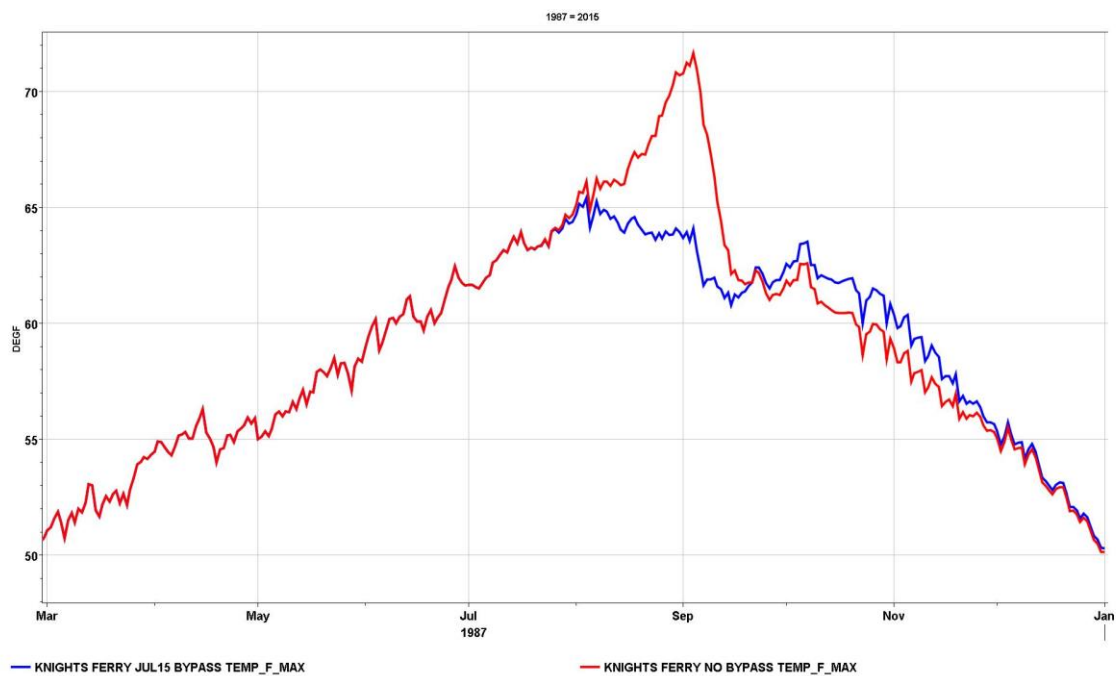


Figure 11 : Maximum Daily Temperatures at Knights Ferry

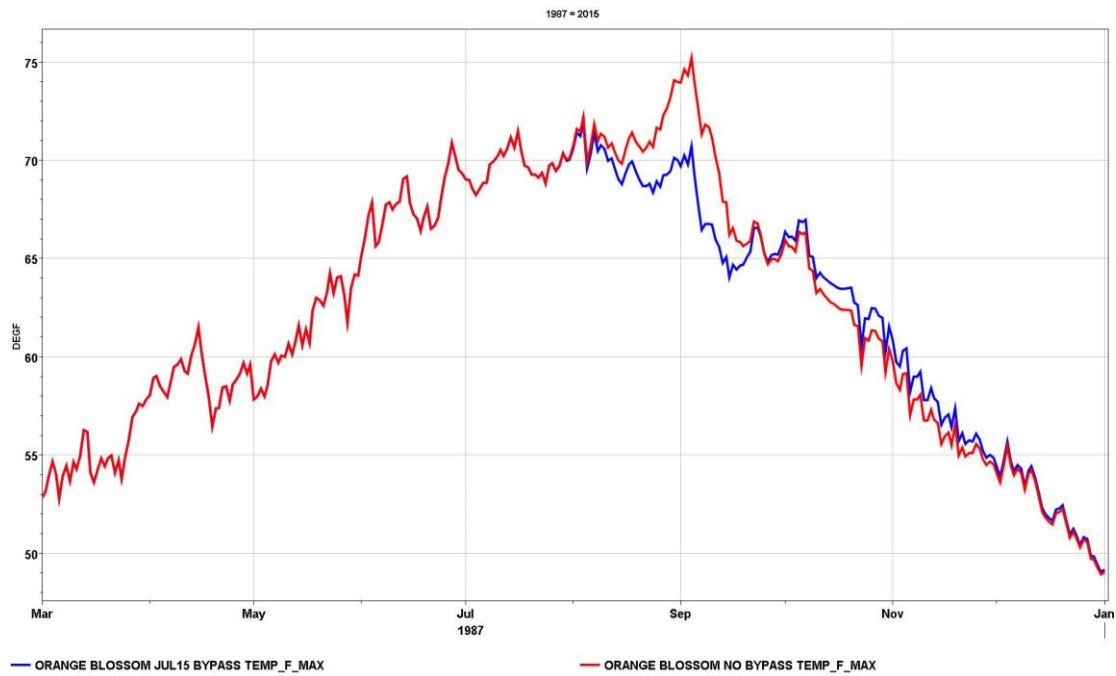


Figure 12 : Maximum Daily Temperatures at Orange Blossom Bridge

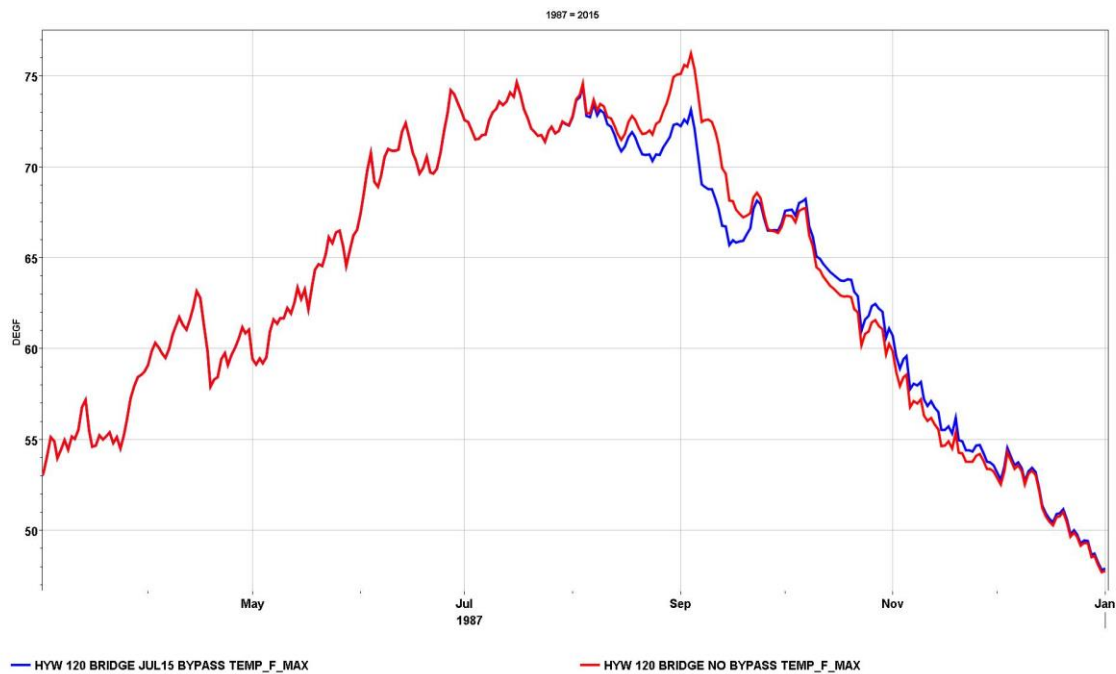


Figure 13 : Maximum Daily Temperatures below Highway 120 (Oakdale)

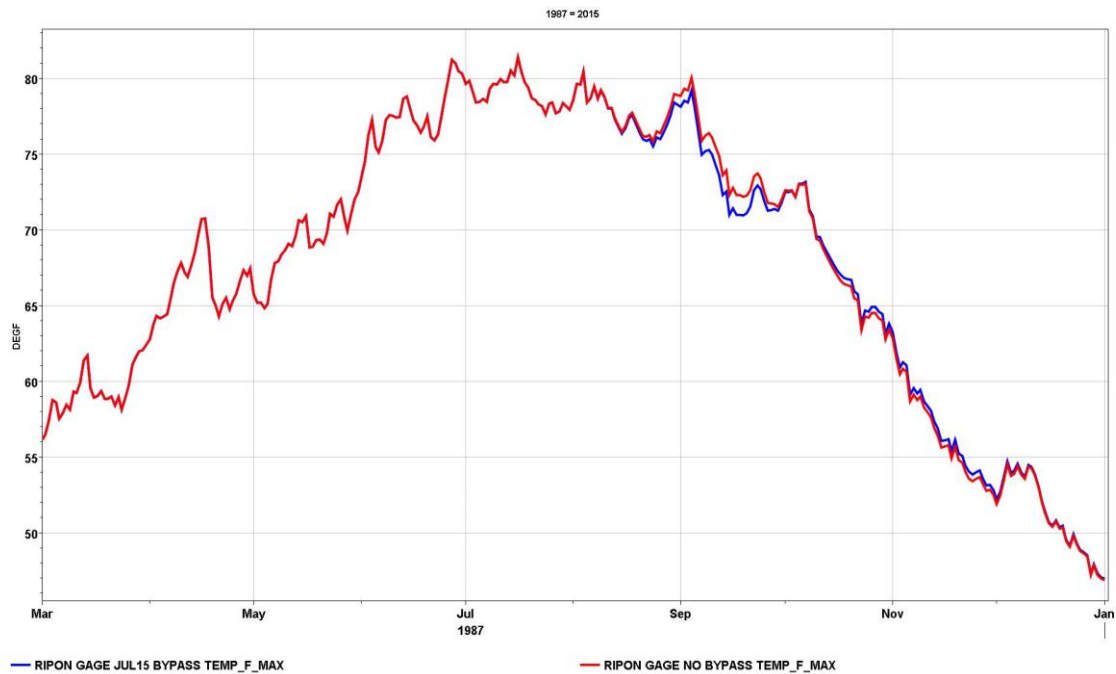


Figure 14 : Maximum Daily Temperatures at Ripon Gage (Highway 99)

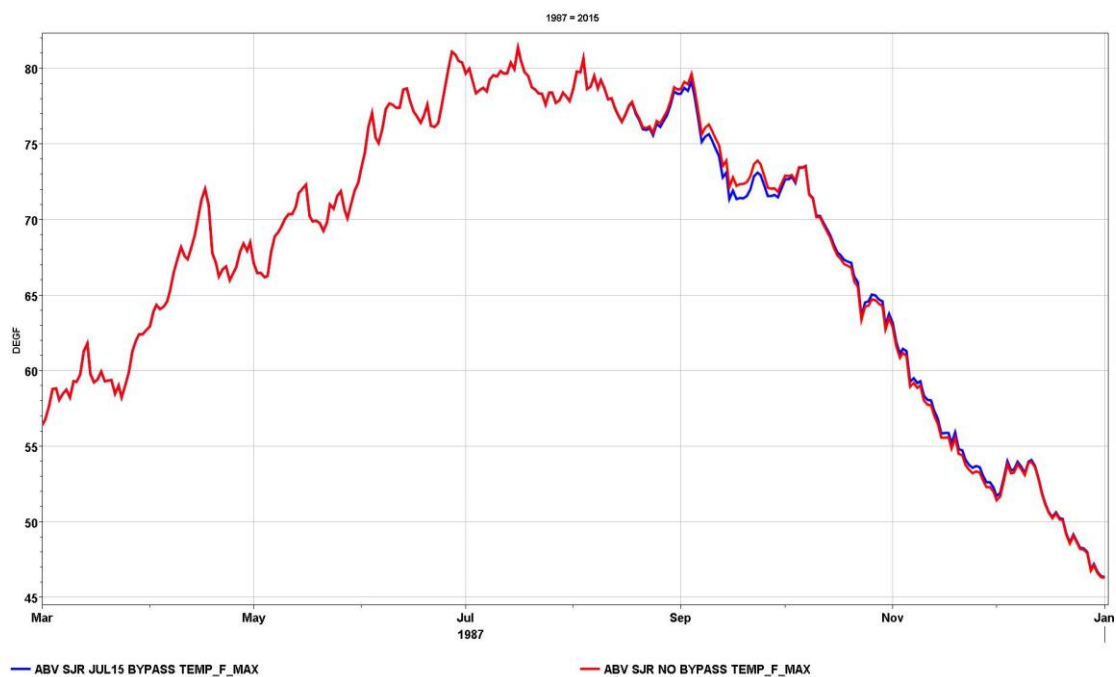


Figure 15 : Maximum Daily Temperatures above the Confluence with the San Joaquin River

**Table 5: Temperature Response – 7DADM
March-April, 2015**

| | BLW GOODWIN | KNIGHTS FERRY | ORANGE BLOSSOM | HYW 120 BRIDGE | RIPON GAGE | ABV SJR |
|--------|--------------|---------------|----------------|----------------|--------------|--------------|
| | JUL15 BYPASS | JUL15 BYPASS | JUL15 BYPASS | JUL15 BYPASS | JUL15 BYPASS | JUL15 BYPASS |
| | 7DADM | 7DADM | 7DADM | 7DADM | 7DADM | 7DADM |
| | DEGF | DEGF | DEGF | DEGF | DEGF | DEGF |
| 1-Mar | 50.5 | 50.6 | 52.2 | 52.3 | 55.4 | 55.6 |
| 2-Mar | 50.6 | 50.8 | 52.5 | 52.5 | 55.7 | 55.9 |
| 3-Mar | 50.8 | 51.1 | 53.0 | 53.1 | 56.4 | 56.6 |
| 4-Mar | 50.8 | 51.2 | 53.3 | 53.5 | 56.9 | 57.1 |
| 5-Mar | 50.7 | 51.2 | 53.4 | 53.8 | 57.2 | 57.5 |
| 6-Mar | 50.7 | 51.3 | 53.6 | 54.1 | 57.5 | 57.8 |
| 7-Mar | 50.8 | 51.4 | 53.8 | 54.4 | 57.9 | 58.2 |
| 8-Mar | 50.9 | 51.5 | 53.9 | 54.6 | 58.1 | 58.4 |
| 9-Mar | 51.0 | 51.5 | 54.0 | 54.7 | 58.4 | 58.6 |
| 10-Mar | 51.0 | 51.5 | 54.0 | 54.7 | 58.4 | 58.7 |
| 11-Mar | 51.3 | 51.7 | 54.1 | 54.8 | 58.6 | 58.8 |
| 12-Mar | 51.6 | 52.0 | 54.6 | 55.2 | 59.2 | 59.3 |
| 13-Mar | 51.8 | 52.2 | 54.9 | 55.6 | 59.7 | 59.8 |
| 14-Mar | 51.8 | 52.2 | 54.9 | 55.7 | 59.9 | 59.9 |
| 15-Mar | 51.9 | 52.3 | 54.8 | 55.7 | 60.0 | 60.0 |
| 16-Mar | 51.9 | 52.3 | 54.8 | 55.6 | 60.0 | 60.1 |
| 17-Mar | 52.0 | 52.4 | 54.9 | 55.6 | 60.0 | 60.2 |
| 18-Mar | 52.0 | 52.4 | 54.8 | 55.6 | 59.8 | 60.1 |
| 19-Mar | 51.9 | 52.3 | 54.6 | 55.3 | 59.5 | 59.8 |
| 20-Mar | 51.9 | 52.3 | 54.4 | 55.1 | 59.1 | 59.5 |
| 21-Mar | 52.0 | 52.3 | 54.4 | 55.0 | 58.9 | 59.3 |
| 22-Mar | 52.1 | 52.5 | 54.6 | 55.1 | 58.9 | 59.3 |
| 23-Mar | 52.2 | 52.5 | 54.5 | 55.0 | 58.8 | 59.1 |
| 24-Mar | 52.2 | 52.5 | 54.5 | 55.0 | 58.7 | 58.9 |
| 25-Mar | 52.3 | 52.7 | 54.7 | 55.2 | 58.8 | 59.0 |
| 26-Mar | 52.5 | 52.8 | 55.0 | 55.5 | 59.2 | 59.3 |
| 27-Mar | 52.6 | 53.0 | 55.3 | 55.9 | 59.5 | 59.7 |
| 28-Mar | 52.8 | 53.3 | 55.8 | 56.4 | 60.1 | 60.3 |
| 29-Mar | 52.9 | 53.5 | 56.2 | 56.9 | 60.5 | 60.7 |
| 30-Mar | 53.1 | 53.8 | 56.8 | 57.5 | 61.1 | 61.4 |
| 31-Mar | 53.3 | 54.1 | 57.3 | 58.0 | 61.7 | 61.9 |
| 1-Apr | 53.3 | 54.3 | 57.7 | 58.6 | 62.2 | 62.5 |
| 2-Apr | 53.4 | 54.4 | 58.0 | 59.0 | 62.7 | 62.9 |
| 3-Apr | 53.4 | 54.5 | 58.2 | 59.3 | 63.1 | 63.2 |
| 4-Apr | 53.4 | 54.5 | 58.3 | 59.5 | 63.4 | 63.5 |
| 5-Apr | 53.3 | 54.6 | 58.4 | 59.6 | 63.7 | 63.8 |
| 6-Apr | 53.3 | 54.6 | 58.5 | 59.8 | 64.1 | 64.2 |
| 7-Apr | 53.3 | 54.7 | 58.7 | 60.0 | 64.7 | 64.7 |
| 8-Apr | 53.3 | 54.8 | 58.8 | 60.2 | 65.2 | 65.2 |
| 9-Apr | 53.4 | 54.8 | 58.9 | 60.4 | 65.7 | 65.7 |
| 10-Apr | 53.4 | 54.9 | 59.0 | 60.6 | 66.1 | 66.3 |
| 11-Apr | 53.5 | 55.0 | 59.1 | 60.8 | 66.5 | 66.7 |
| 12-Apr | 53.7 | 55.1 | 59.4 | 61.1 | 66.9 | 67.2 |
| 13-Apr | 53.8 | 55.3 | 59.7 | 61.4 | 67.4 | 67.7 |
| 14-Apr | 53.9 | 55.5 | 60.0 | 61.8 | 67.9 | 68.3 |
| 15-Apr | 53.8 | 55.5 | 60.1 | 62.0 | 68.4 | 68.8 |
| 16-Apr | 53.8 | 55.4 | 60.0 | 61.9 | 68.8 | 69.4 |
| 17-Apr | 53.8 | 55.4 | 59.8 | 61.7 | 69.0 | 69.9 |
| 18-Apr | 53.7 | 55.2 | 59.4 | 61.3 | 68.8 | 69.9 |
| 19-Apr | 53.6 | 55.1 | 59.0 | 60.8 | 68.4 | 69.8 |
| 20-Apr | 53.5 | 54.9 | 58.6 | 60.3 | 67.8 | 69.4 |
| 21-Apr | 53.5 | 54.8 | 58.1 | 59.7 | 67.2 | 68.9 |
| 22-Apr | 53.5 | 54.7 | 57.9 | 59.3 | 66.4 | 68.2 |
| 23-Apr | 53.6 | 54.7 | 57.7 | 59.0 | 65.6 | 67.4 |
| 24-Apr | 53.7 | 54.8 | 57.8 | 58.9 | 65.1 | 66.7 |
| 25-Apr | 53.8 | 55.0 | 58.1 | 59.2 | 65.1 | 66.6 |
| 26-Apr | 53.9 | 55.2 | 58.4 | 59.6 | 65.3 | 66.7 |
| 27-Apr | 54.0 | 55.4 | 58.7 | 60.0 | 65.8 | 67.0 |
| 28-Apr | 54.1 | 55.4 | 58.8 | 60.2 | 66.0 | 67.2 |
| 29-Apr | 54.2 | 55.5 | 59.0 | 60.3 | 66.3 | 67.4 |
| 30-Apr | 54.2 | 55.6 | 59.0 | 60.4 | 66.5 | 67.6 |

**Table 6: Temperature Response – 7DADM
May-June, 2015**

| | BLW GOODWIN | KNIGHTS FERRY | ORANGE BLOSSOM | HYW 120 BRIDGE | RIPON GAGE | ABV SJR |
|--------|--------------|---------------|----------------|----------------|--------------|--------------|
| | JUL15 BYPASS | JUL15 BYPASS | JUL15 BYPASS | JUL15 BYPASS | JUL15 BYPASS | JUL15 BYPASS |
| | 7DADM | 7DADM | 7DADM | 7DADM | 7DADM | 7DADM |
| | DEGF | DEGF | DEGF | DEGF | DEGF | DEGF |
| 1-May | 54.2 | 55.5 | 58.9 | 60.3 | 66.4 | 67.6 |
| 2-May | 54.2 | 55.5 | 58.8 | 60.2 | 66.4 | 67.5 |
| 3-May | 54.2 | 55.4 | 58.7 | 60.0 | 66.1 | 67.3 |
| 4-May | 54.1 | 55.4 | 58.5 | 59.8 | 65.8 | 67.0 |
| 5-May | 54.1 | 55.4 | 58.6 | 59.8 | 65.7 | 67.0 |
| 6-May | 54.2 | 55.5 | 58.7 | 59.9 | 65.8 | 67.0 |
| 7-May | 54.2 | 55.6 | 58.9 | 60.2 | 66.1 | 67.3 |
| 8-May | 54.3 | 55.8 | 59.2 | 60.5 | 66.6 | 67.8 |
| 9-May | 54.4 | 55.9 | 59.4 | 60.9 | 67.1 | 68.3 |
| 10-May | 54.5 | 56.1 | 59.8 | 61.3 | 67.7 | 68.9 |
| 11-May | 54.6 | 56.2 | 60.1 | 61.6 | 68.2 | 69.4 |
| 12-May | 54.7 | 56.3 | 60.2 | 61.9 | 68.6 | 69.9 |
| 13-May | 54.8 | 56.4 | 60.4 | 62.1 | 69.0 | 70.3 |
| 14-May | 54.8 | 56.5 | 60.6 | 62.3 | 69.4 | 70.7 |
| 15-May | 54.9 | 56.6 | 60.7 | 62.5 | 69.7 | 71.1 |
| 16-May | 55.0 | 56.8 | 60.8 | 62.6 | 69.8 | 71.1 |
| 17-May | 55.0 | 56.9 | 61.1 | 62.8 | 69.8 | 71.1 |
| 18-May | 55.1 | 57.2 | 61.5 | 63.1 | 69.8 | 71.0 |
| 19-May | 55.1 | 57.4 | 61.8 | 63.4 | 69.8 | 70.8 |
| 20-May | 55.1 | 57.4 | 61.9 | 63.6 | 69.5 | 70.5 |
| 21-May | 55.2 | 57.7 | 62.3 | 63.9 | 69.4 | 70.2 |
| 22-May | 55.2 | 57.9 | 62.7 | 64.3 | 69.5 | 70.0 |
| 23-May | 55.2 | 58.0 | 63.1 | 64.9 | 69.8 | 70.0 |
| 24-May | 55.2 | 58.0 | 63.3 | 65.3 | 70.2 | 70.3 |
| 25-May | 55.2 | 58.1 | 63.5 | 65.6 | 70.5 | 70.6 |
| 26-May | 55.2 | 58.1 | 63.5 | 65.7 | 70.7 | 70.7 |
| 27-May | 55.1 | 58.0 | 63.4 | 65.7 | 70.9 | 70.8 |
| 28-May | 55.2 | 58.0 | 63.4 | 65.8 | 71.0 | 71.0 |
| 29-May | 55.2 | 58.0 | 63.4 | 65.8 | 71.2 | 71.1 |
| 30-May | 55.2 | 58.1 | 63.5 | 65.9 | 71.4 | 71.4 |
| 31-May | 55.3 | 58.2 | 63.7 | 66.0 | 71.7 | 71.6 |
| 1-Jun | 55.3 | 58.3 | 64.0 | 66.3 | 72.0 | 72.0 |
| 2-Jun | 55.4 | 58.6 | 64.6 | 66.9 | 72.8 | 72.8 |
| 3-Jun | 55.6 | 59.1 | 65.4 | 67.8 | 73.9 | 73.8 |
| 4-Jun | 55.6 | 59.2 | 65.7 | 68.3 | 74.5 | 74.4 |
| 5-Jun | 55.6 | 59.3 | 66.0 | 68.7 | 74.9 | 74.8 |
| 6-Jun | 55.6 | 59.4 | 66.3 | 69.1 | 75.4 | 75.3 |
| 7-Jun | 55.7 | 59.6 | 66.7 | 69.6 | 76.0 | 75.9 |
| 8-Jun | 55.8 | 59.7 | 67.0 | 69.9 | 76.4 | 76.4 |
| 9-Jun | 55.8 | 59.7 | 67.0 | 70.1 | 76.6 | 76.6 |
| 10-Jun | 55.9 | 59.8 | 67.0 | 70.1 | 76.6 | 76.6 |
| 11-Jun | 56.0 | 60.0 | 67.3 | 70.4 | 76.9 | 76.9 |
| 12-Jun | 56.2 | 60.3 | 67.8 | 70.8 | 77.4 | 77.4 |
| 13-Jun | 56.3 | 60.5 | 68.1 | 71.2 | 77.8 | 77.8 |
| 14-Jun | 56.3 | 60.5 | 68.2 | 71.4 | 77.9 | 77.9 |
| 15-Jun | 56.4 | 60.5 | 68.1 | 71.3 | 77.9 | 77.8 |
| 16-Jun | 56.4 | 60.5 | 68.0 | 71.3 | 77.8 | 77.7 |
| 17-Jun | 56.4 | 60.4 | 67.8 | 71.1 | 77.6 | 77.6 |
| 18-Jun | 56.5 | 60.4 | 67.7 | 70.9 | 77.5 | 77.5 |
| 19-Jun | 56.5 | 60.3 | 67.5 | 70.7 | 77.4 | 77.3 |
| 20-Jun | 56.5 | 60.1 | 67.1 | 70.4 | 77.0 | 77.0 |
| 21-Jun | 56.6 | 60.1 | 66.9 | 70.1 | 76.7 | 76.7 |
| 22-Jun | 56.7 | 60.2 | 66.9 | 70.0 | 76.6 | 76.6 |
| 23-Jun | 56.8 | 60.3 | 67.1 | 70.0 | 76.6 | 76.7 |
| 24-Jun | 57.0 | 60.6 | 67.5 | 70.4 | 77.0 | 77.0 |
| 25-Jun | 57.1 | 60.8 | 67.9 | 70.8 | 77.4 | 77.5 |
| 26-Jun | 57.2 | 61.1 | 68.3 | 71.3 | 77.9 | 78.0 |
| 27-Jun | 57.3 | 61.4 | 68.8 | 71.9 | 78.6 | 78.6 |
| 28-Jun | 57.4 | 61.6 | 69.2 | 72.5 | 79.3 | 79.2 |
| 29-Jun | 57.5 | 61.7 | 69.6 | 72.9 | 79.9 | 79.8 |
| 30-Jun | 57.6 | 61.8 | 69.7 | 73.2 | 80.2 | 80.2 |

Table 7: Temperature Response – 7DADM
July-August, 2015

| | BLW GOODWIN | KNIGHTS FERRY | ORANGE BLOSSOM | HYW 120 BRIDGE | RIPON GAGE | ABV SJR |
|--------|--------------|---------------|----------------|----------------|--------------|--------------|
| | JUL15 BYPASS | JUL15 BYPASS | JUL15 BYPASS | JUL15 BYPASS | JUL15 BYPASS | JUL15 BYPASS |
| | 7DADM | 7DADM | 7DADM | 7DADM | 7DADM | 7DADM |
| | DEGF | DEGF | DEGF | DEGF | DEGF | DEGF |
| 1-Jul | 57.7 | 61.9 | 69.7 | 73.3 | 80.3 | 80.3 |
| 2-Jul | 57.8 | 61.8 | 69.5 | 73.1 | 80.2 | 80.2 |
| 3-Jul | 57.8 | 61.7 | 69.1 | 72.7 | 79.8 | 79.8 |
| 4-Jul | 57.9 | 61.6 | 68.9 | 72.4 | 79.5 | 79.5 |
| 5-Jul | 58.1 | 61.7 | 68.8 | 72.1 | 79.2 | 79.3 |
| 6-Jul | 58.2 | 61.7 | 68.7 | 71.9 | 78.9 | 79.0 |
| 7-Jul | 58.4 | 61.9 | 68.8 | 71.9 | 78.9 | 78.9 |
| 8-Jul | 58.6 | 62.0 | 69.0 | 72.0 | 78.9 | 78.9 |
| 9-Jul | 58.7 | 62.2 | 69.2 | 72.2 | 78.9 | 78.9 |
| 10-Jul | 58.9 | 62.5 | 69.5 | 72.5 | 79.1 | 79.1 |
| 11-Jul | 59.1 | 62.6 | 69.8 | 72.8 | 79.3 | 79.3 |
| 12-Jul | 59.2 | 62.9 | 70.0 | 73.0 | 79.5 | 79.4 |
| 13-Jul | 59.4 | 63.1 | 70.3 | 73.3 | 79.8 | 79.7 |
| 14-Jul | 59.6 | 63.2 | 70.5 | 73.5 | 79.9 | 79.8 |
| 15-Jul | 59.7 | 63.4 | 70.7 | 73.8 | 80.2 | 80.0 |
| 16-Jul | 59.8 | 63.5 | 70.7 | 73.9 | 80.3 | 80.2 |
| 17-Jul | 59.9 | 63.5 | 70.6 | 73.8 | 80.3 | 80.2 |
| 18-Jul | 60.1 | 63.5 | 70.5 | 73.7 | 80.2 | 80.2 |
| 19-Jul | 60.2 | 63.5 | 70.3 | 73.5 | 80.1 | 80.0 |
| 20-Jul | 60.3 | 63.4 | 70.1 | 73.2 | 79.8 | 79.8 |
| 21-Jul | 60.4 | 63.4 | 69.9 | 72.9 | 79.5 | 79.5 |
| 22-Jul | 60.6 | 63.3 | 69.6 | 72.5 | 79.1 | 79.1 |
| 23-Jul | 60.7 | 63.3 | 69.3 | 72.1 | 78.6 | 78.7 |
| 24-Jul | 60.9 | 63.4 | 69.3 | 71.9 | 78.4 | 78.5 |
| 25-Jul | 61.0 | 63.5 | 69.3 | 71.9 | 78.3 | 78.3 |
| 26-Jul | 61.1 | 63.6 | 69.4 | 71.8 | 78.1 | 78.2 |
| 27-Jul | 61.3 | 63.8 | 69.4 | 71.8 | 78.0 | 78.1 |
| 28-Jul | 61.4 | 63.9 | 69.6 | 71.9 | 78.0 | 78.1 |
| 29-Jul | 61.5 | 64.0 | 69.7 | 72.0 | 78.0 | 78.1 |
| 30-Jul | 61.6 | 64.2 | 69.9 | 72.2 | 78.1 | 78.1 |
| 31-Jul | 61.7 | 64.3 | 70.0 | 72.3 | 78.1 | 78.1 |
| 1-Aug | 61.7 | 64.4 | 70.2 | 72.5 | 78.3 | 78.3 |
| 2-Aug | 61.8 | 64.6 | 70.5 | 72.7 | 78.6 | 78.6 |
| 3-Aug | 61.9 | 64.8 | 70.8 | 73.1 | 79.0 | 79.0 |
| 4-Aug | 61.9 | 64.7 | 70.7 | 73.1 | 79.0 | 79.1 |
| 5-Aug | 62.0 | 64.8 | 70.7 | 73.2 | 79.0 | 79.1 |
| 6-Aug | 62.1 | 64.9 | 70.9 | 73.4 | 79.3 | 79.4 |
| 7-Aug | 62.1 | 64.9 | 70.9 | 73.4 | 79.3 | 79.4 |
| 8-Aug | 62.1 | 64.9 | 70.8 | 73.3 | 79.2 | 79.3 |
| 9-Aug | 62.1 | 64.8 | 70.7 | 73.2 | 79.1 | 79.2 |
| 10-Aug | 62.1 | 64.7 | 70.4 | 72.9 | 78.7 | 78.8 |
| 11-Aug | 62.2 | 64.8 | 70.5 | 72.8 | 78.7 | 78.7 |
| 12-Aug | 62.2 | 64.7 | 70.4 | 72.7 | 78.5 | 78.5 |
| 13-Aug | 62.1 | 64.6 | 70.1 | 72.4 | 78.1 | 78.1 |
| 14-Aug | 62.1 | 64.4 | 69.8 | 72.1 | 77.8 | 77.8 |
| 15-Aug | 62.0 | 64.4 | 69.6 | 71.8 | 77.4 | 77.5 |
| 16-Aug | 62.0 | 64.3 | 69.5 | 71.6 | 77.2 | 77.3 |
| 17-Aug | 62.0 | 64.3 | 69.5 | 71.5 | 77.2 | 77.3 |
| 18-Aug | 62.0 | 64.3 | 69.4 | 71.5 | 77.0 | 77.1 |
| 19-Aug | 61.9 | 64.2 | 69.3 | 71.4 | 76.9 | 77.0 |
| 20-Aug | 61.9 | 64.2 | 69.3 | 71.3 | 76.8 | 76.9 |
| 21-Aug | 61.9 | 64.2 | 69.3 | 71.3 | 76.7 | 76.8 |
| 22-Aug | 61.8 | 64.1 | 69.2 | 71.2 | 76.6 | 76.7 |
| 23-Aug | 61.7 | 64.0 | 69.0 | 71.0 | 76.3 | 76.4 |
| 24-Aug | 61.6 | 63.9 | 68.8 | 70.8 | 76.1 | 76.2 |
| 25-Aug | 61.5 | 63.8 | 68.7 | 70.7 | 76.0 | 76.1 |
| 26-Aug | 61.4 | 63.8 | 68.8 | 70.7 | 76.0 | 76.1 |
| 27-Aug | 61.3 | 63.8 | 68.8 | 70.8 | 76.1 | 76.2 |
| 28-Aug | 61.2 | 63.8 | 69.0 | 70.9 | 76.3 | 76.4 |
| 29-Aug | 61.1 | 63.8 | 69.1 | 71.2 | 76.7 | 76.8 |
| 30-Aug | 61.0 | 63.9 | 69.4 | 71.4 | 77.1 | 77.2 |
| 31-Aug | 60.9 | 63.9 | 69.5 | 71.7 | 77.4 | 77.4 |

**Table 8: Temperature Response – 7DADM
September-October, 2015**

| | BLW GOODWIN | KNIGHTS FERRY | ORANGE BLOSSOM | HYW 120 BRIDGE | RIPON GAGE | ABV SJR |
|--------|--------------|---------------|----------------|----------------|--------------|--------------|
| | JUL15 BYPASS | JUL15 BYPASS | JUL15 BYPASS | JUL15 BYPASS | JUL15 BYPASS | JUL15 BYPASS |
| | 7DADM | 7DADM | 7DADM | 7DADM | 7DADM | 7DADM |
| | DEGF | DEGF | DEGF | DEGF | DEGF | DEGF |
| 1-Sep | 60.9 | 63.9 | 69.7 | 71.9 | 77.7 | 77.8 |
| 2-Sep | 60.9 | 63.8 | 69.8 | 72.1 | 78.0 | 78.1 |
| 3-Sep | 61.0 | 63.9 | 70.0 | 72.4 | 78.3 | 78.4 |
| 4-Sep | 60.9 | 63.8 | 70.0 | 72.4 | 78.4 | 78.5 |
| 5-Sep | 60.8 | 63.5 | 69.6 | 72.2 | 78.2 | 78.3 |
| 6-Sep | 60.7 | 63.2 | 69.1 | 71.7 | 77.7 | 77.8 |
| 7-Sep | 60.6 | 62.9 | 68.7 | 71.2 | 77.3 | 77.4 |
| 8-Sep | 60.4 | 62.6 | 68.2 | 70.7 | 76.8 | 77.0 |
| 9-Sep | 60.4 | 62.4 | 67.8 | 70.2 | 76.3 | 76.5 |
| 10-Sep | 60.2 | 62.1 | 67.1 | 69.5 | 75.6 | 75.9 |
| 11-Sep | 60.1 | 61.8 | 66.6 | 68.8 | 75.0 | 75.3 |
| 12-Sep | 60.1 | 61.6 | 66.1 | 68.3 | 74.4 | 74.7 |
| 13-Sep | 60.1 | 61.6 | 65.9 | 68.0 | 74.0 | 74.4 |
| 14-Sep | 60.1 | 61.5 | 65.6 | 67.5 | 73.4 | 73.9 |
| 15-Sep | 60.2 | 61.4 | 65.3 | 67.1 | 72.9 | 73.3 |
| 16-Sep | 60.2 | 61.2 | 64.9 | 66.7 | 72.3 | 72.8 |
| 17-Sep | 60.2 | 61.2 | 64.7 | 66.4 | 71.8 | 72.3 |
| 18-Sep | 60.3 | 61.2 | 64.6 | 66.1 | 71.4 | 71.9 |
| 19-Sep | 60.3 | 61.3 | 64.7 | 66.0 | 71.3 | 71.7 |
| 20-Sep | 60.4 | 61.3 | 64.7 | 66.0 | 71.1 | 71.6 |
| 21-Sep | 60.5 | 61.5 | 65.1 | 66.3 | 71.4 | 71.8 |
| 22-Sep | 60.6 | 61.7 | 65.3 | 66.6 | 71.6 | 71.9 |
| 23-Sep | 60.7 | 61.9 | 65.6 | 66.9 | 71.8 | 72.2 |
| 24-Sep | 60.7 | 61.9 | 65.7 | 67.1 | 72.0 | 72.3 |
| 25-Sep | 60.7 | 61.9 | 65.7 | 67.2 | 72.0 | 72.3 |
| 26-Sep | 60.8 | 62.0 | 65.7 | 67.2 | 72.0 | 72.3 |
| 27-Sep | 60.8 | 62.0 | 65.7 | 67.2 | 72.0 | 72.3 |
| 28-Sep | 60.8 | 61.9 | 65.5 | 67.0 | 71.8 | 72.1 |
| 29-Sep | 60.8 | 61.9 | 65.4 | 66.9 | 71.6 | 71.9 |
| 30-Sep | 60.9 | 61.9 | 65.4 | 66.8 | 71.6 | 71.9 |
| 1-Oct | 61.2 | 62.0 | 65.5 | 66.9 | 71.7 | 71.9 |
| 2-Oct | 61.5 | 62.2 | 65.7 | 67.0 | 71.9 | 72.1 |
| 3-Oct | 61.7 | 62.3 | 65.8 | 67.1 | 72.0 | 72.2 |
| 4-Oct | 62.0 | 62.5 | 66.0 | 67.4 | 72.3 | 72.5 |
| 5-Oct | 62.3 | 62.8 | 66.3 | 67.6 | 72.5 | 72.8 |
| 6-Oct | 62.5 | 63.0 | 66.5 | 67.8 | 72.7 | 73.0 |
| 7-Oct | 62.5 | 63.0 | 66.3 | 67.7 | 72.5 | 72.8 |
| 8-Oct | 62.4 | 63.0 | 66.1 | 67.5 | 72.3 | 72.7 |
| 9-Oct | 62.2 | 62.9 | 65.8 | 67.1 | 71.9 | 72.3 |
| 10-Oct | 62.1 | 62.8 | 65.6 | 66.7 | 71.5 | 72.0 |
| 11-Oct | 61.8 | 62.6 | 65.2 | 66.3 | 70.9 | 71.5 |
| 12-Oct | 61.7 | 62.3 | 64.8 | 65.7 | 70.3 | 70.9 |
| 13-Oct | 61.5 | 62.1 | 64.3 | 65.2 | 69.6 | 70.3 |
| 14-Oct | 61.5 | 62.0 | 64.1 | 64.8 | 69.0 | 69.8 |
| 15-Oct | 61.6 | 61.9 | 63.9 | 64.5 | 68.5 | 69.3 |
| 16-Oct | 61.6 | 61.9 | 63.8 | 64.3 | 68.2 | 68.9 |
| 17-Oct | 61.7 | 61.9 | 63.7 | 64.1 | 67.8 | 68.5 |
| 18-Oct | 61.7 | 61.8 | 63.6 | 64.0 | 67.5 | 68.1 |
| 19-Oct | 61.7 | 61.9 | 63.5 | 63.9 | 67.2 | 67.8 |
| 20-Oct | 61.7 | 61.8 | 63.4 | 63.7 | 66.9 | 67.4 |
| 21-Oct | 61.7 | 61.7 | 63.3 | 63.6 | 66.6 | 67.0 |
| 22-Oct | 61.5 | 61.5 | 62.8 | 63.1 | 66.1 | 66.4 |
| 23-Oct | 61.6 | 61.4 | 62.6 | 62.8 | 65.8 | 66.0 |
| 24-Oct | 61.6 | 61.2 | 62.4 | 62.6 | 65.4 | 65.6 |
| 25-Oct | 61.6 | 61.2 | 62.3 | 62.4 | 65.2 | 65.3 |
| 26-Oct | 61.6 | 61.1 | 62.1 | 62.2 | 64.9 | 65.0 |
| 27-Oct | 61.6 | 61.1 | 62.0 | 62.0 | 64.7 | 64.7 |
| 28-Oct | 61.5 | 61.1 | 61.9 | 61.9 | 64.5 | 64.6 |
| 29-Oct | 61.5 | 61.1 | 61.9 | 61.9 | 64.5 | 64.5 |
| 30-Oct | 61.4 | 61.1 | 61.8 | 61.8 | 64.3 | 64.4 |
| 31-Oct | 61.4 | 61.0 | 61.7 | 61.6 | 64.1 | 64.2 |

6. Projected Energy Loss Due to Bypass Operation

A simplified hydropower calculation was performed to estimate the energy loss due to the bypass operation. The no-bypass case was compared with the July 15 bypass case, as follows:

| | No Bypass | July 15 Bypass | Energy Loss |
|--------------|--------------|-------------------|----------------|
| | MWh | MWh | MWh |
| Jan | | | |
| Feb | | | |
| Mar | 13,296 | 13,296 | 0 |
| Apr | 20,728 | 20,728 | 0 |
| May | 25,176 | 25,176 | 0 |
| Jun | 23,731 | 23,731 | 0 |
| Jul | 22,891 | 21,124 | (1,768) |
| Aug | 18,471 | 7,423 | (11,047) |
| Sep | 0 | 0 | 0 |
| Oct | 0 | 0 | 0 |
| Nov | 0 | 0 | 0 |
| Dec | 0 | 0 | 0 |
| Total | 134,546 | 121,731 | (12,815) |

Figure 16: Projected Energy Loss Due to Bypass Operation

Figure 16 shows that the energy loss during the bypass period, July 15 through August 31, 2015, will be in the order of 12,815 MWh. Based on PG&E SRAC (Short-Term Avoided Cost) for qualifying facilities, the cost per KWh in July and August of 2014 was approximately 5 cents. If we use the same price rate for this year, the loss of energy could amount to \$640,747.